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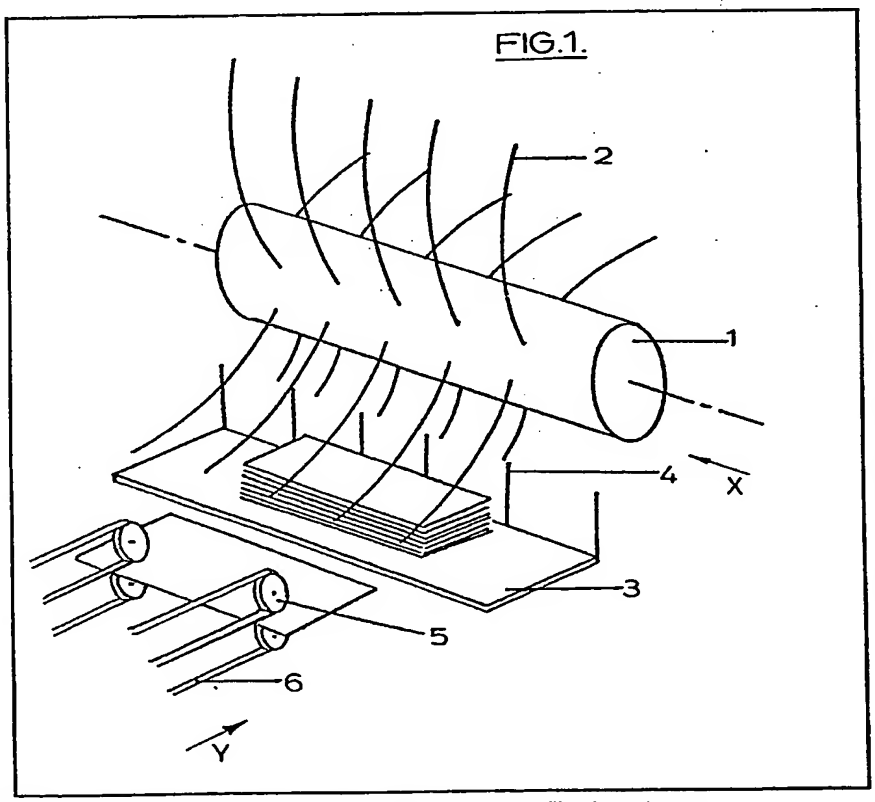
(54) **Asynchronous sheet stacking apparatus**

(57) A stacking apparatus for sheets such as banknotes has note feeding rollers (5) and belts (6). The notes are fed into the path of flexible flails (2) carried by a rotating roller (1), and the flails direct the notes towards a horizontal support surface 3 and against a series of vertical projections (4) to form a stack of notes.

FIG.1.



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The drawings originally filed were informal and the print here reproduced is taken from a later filed formal copy.

FIG.1.

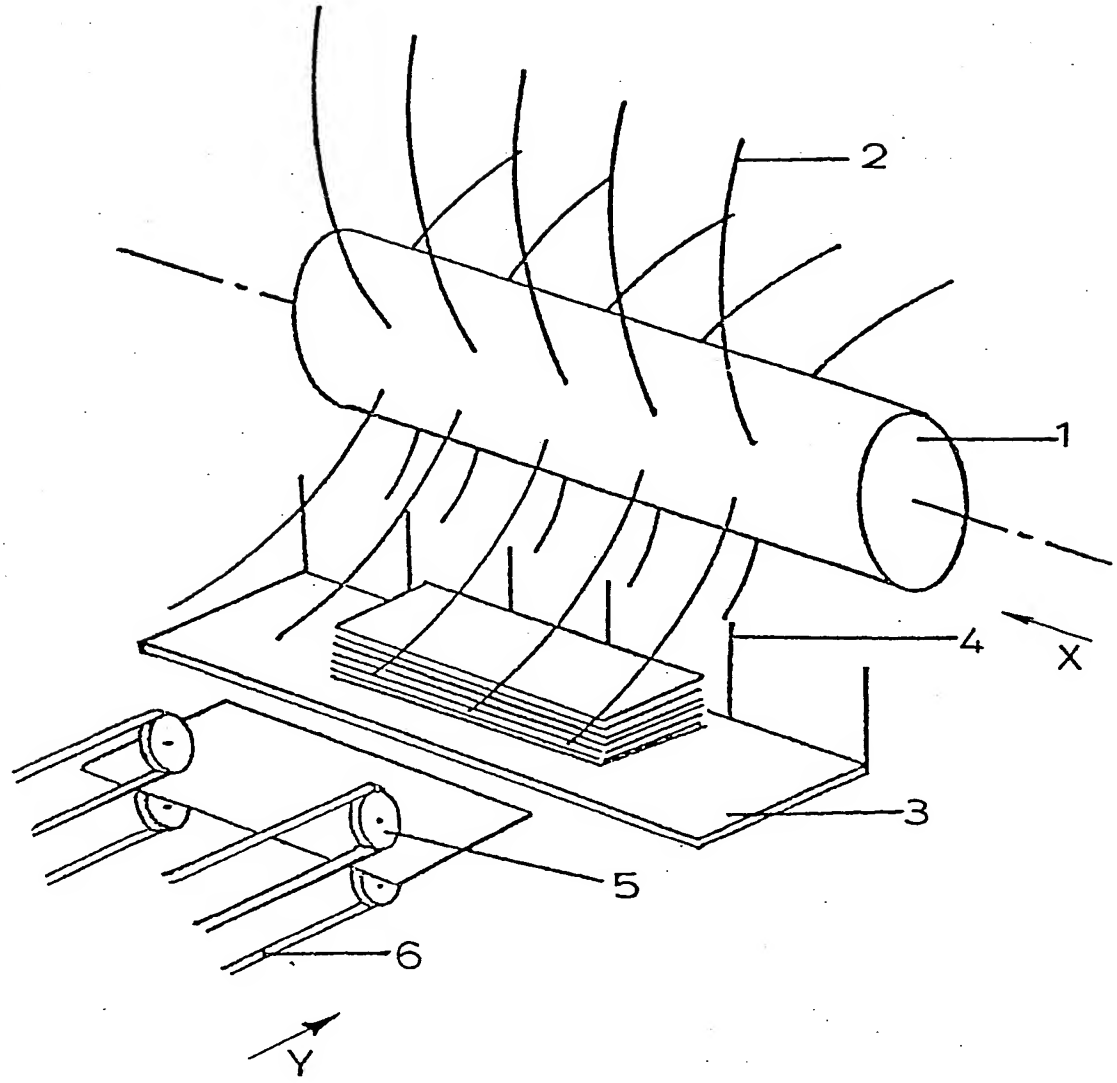


FIG.2.

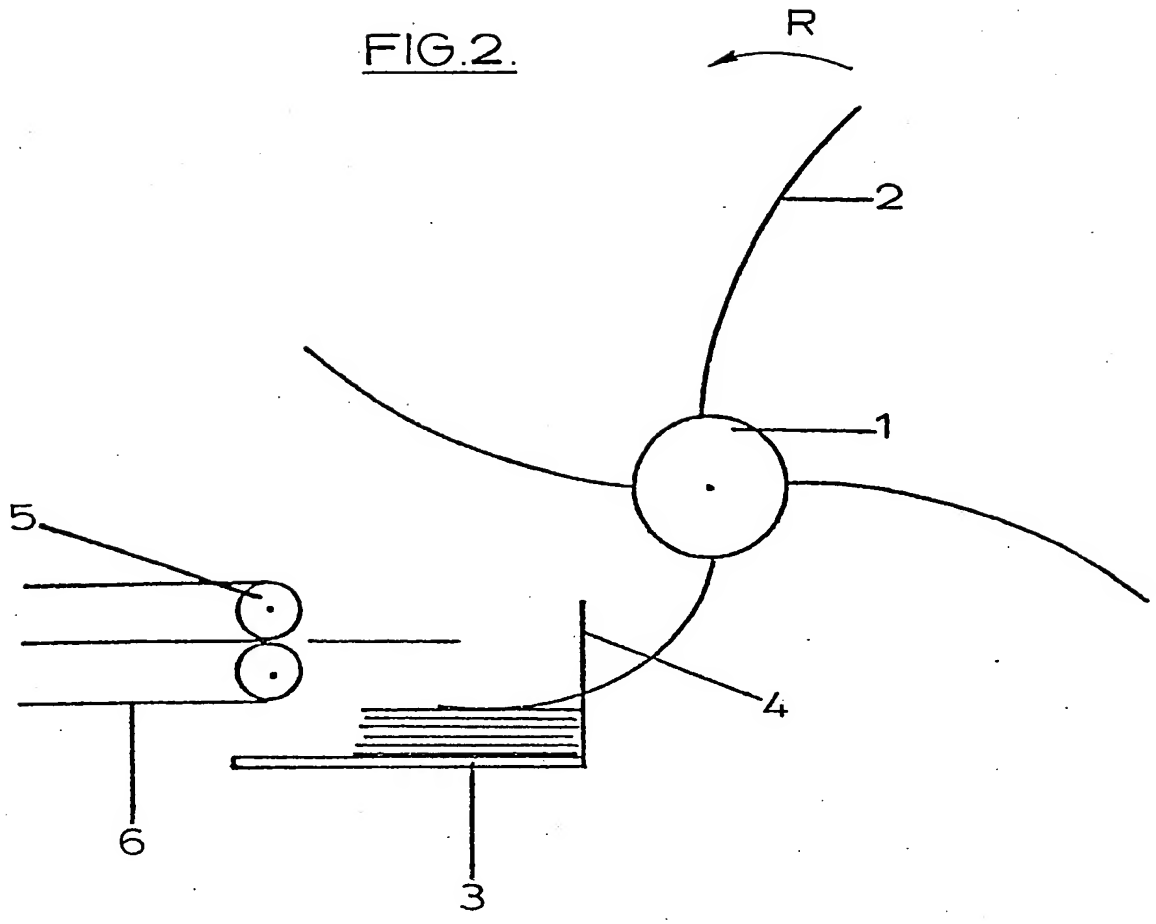
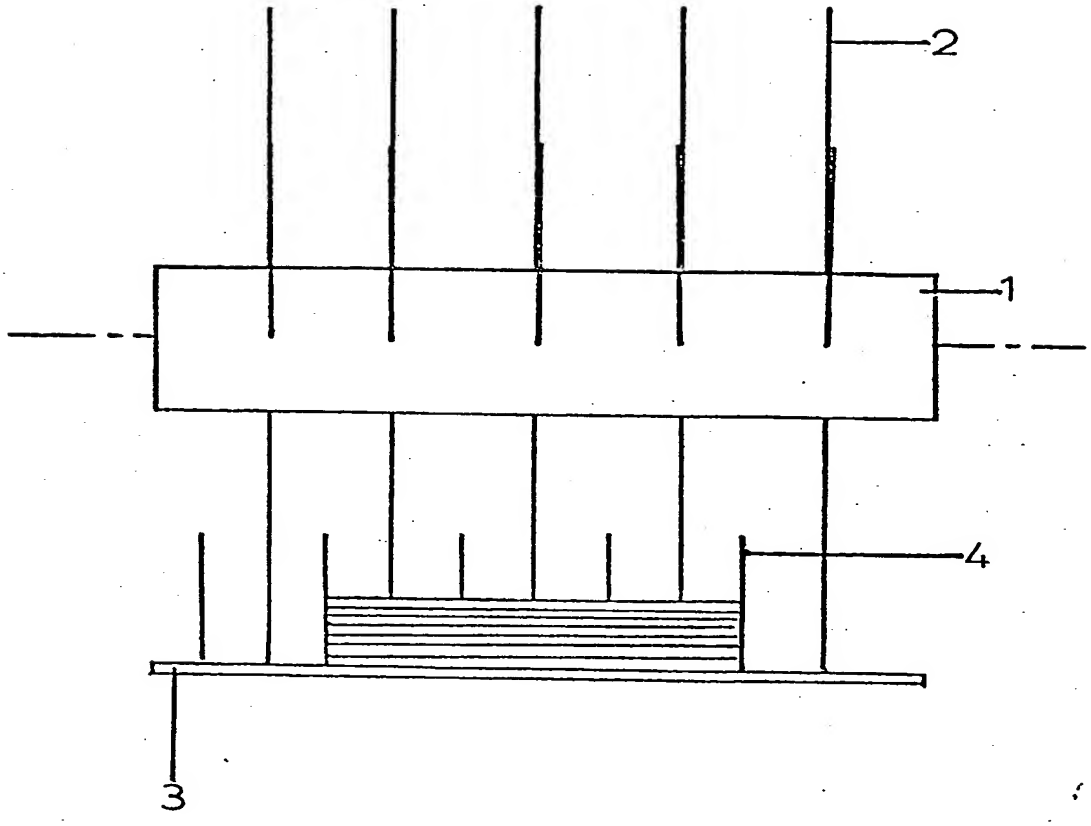


FIG. 3.



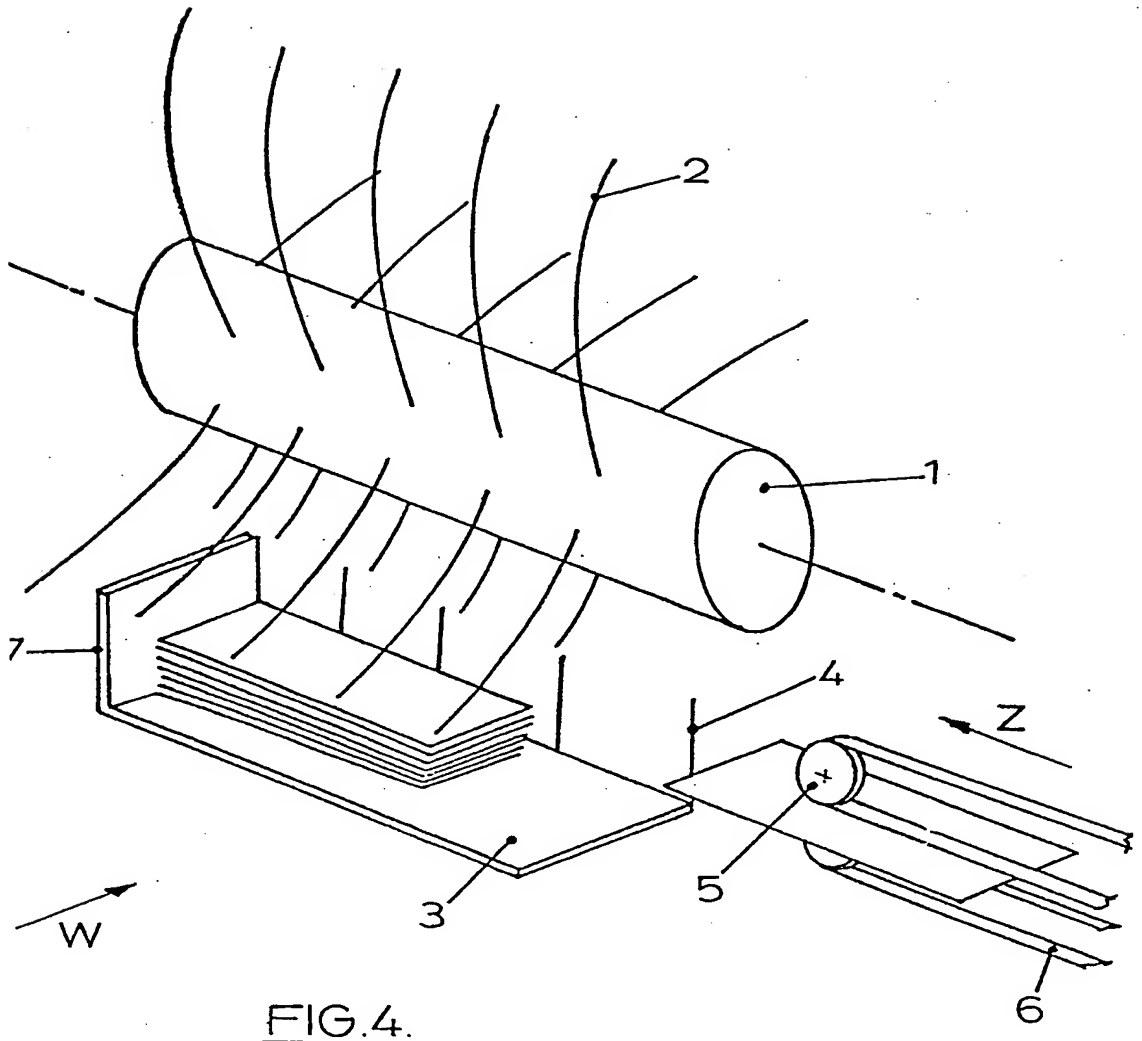


FIG.4.

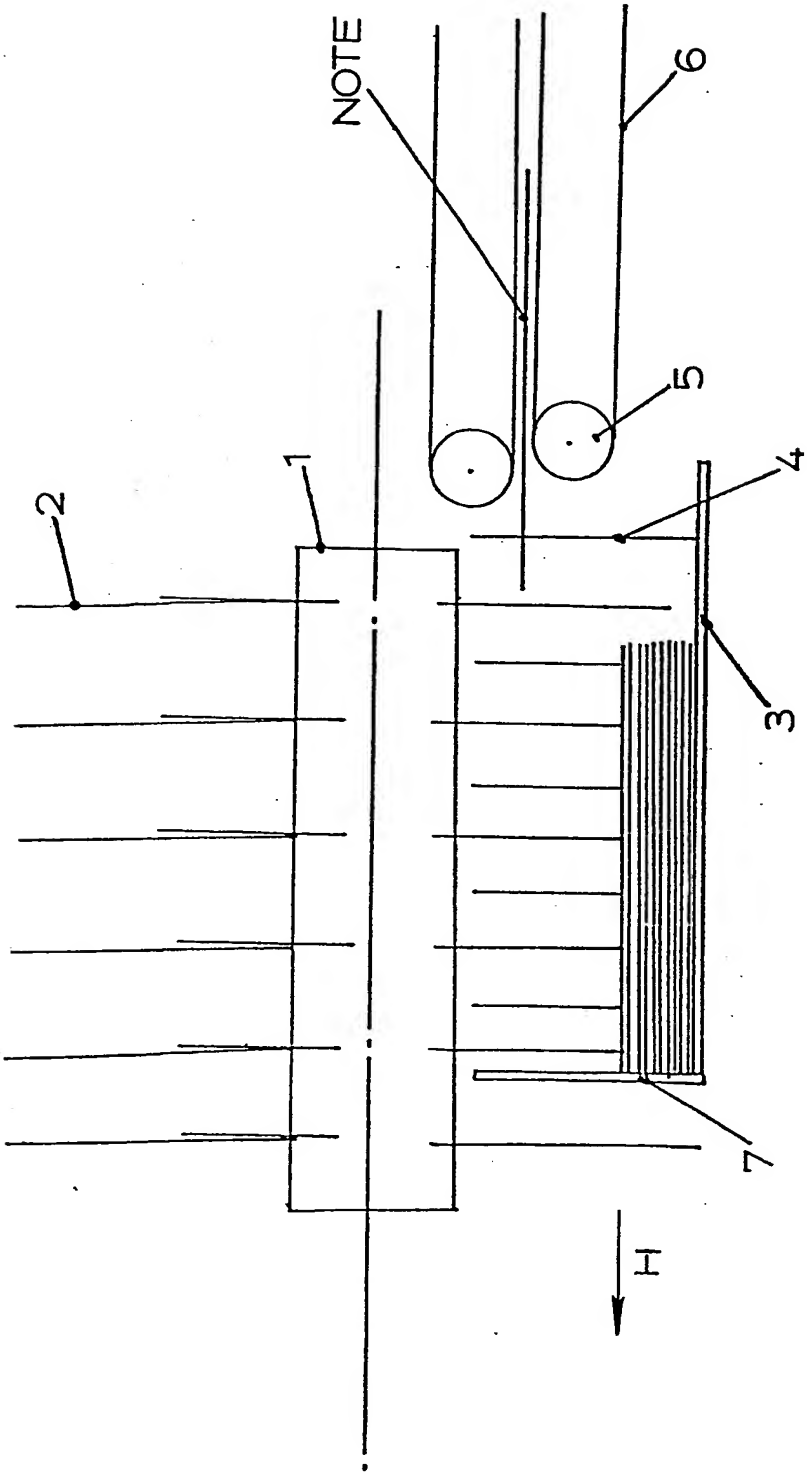


FIG.5.

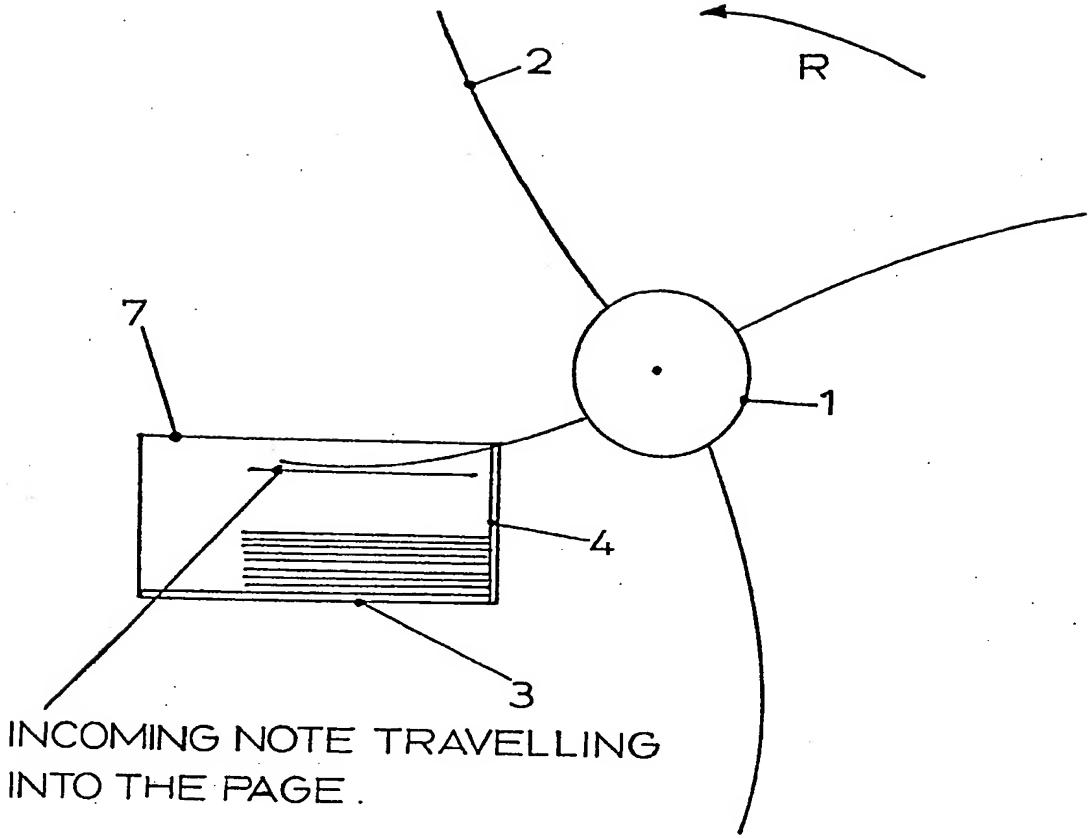


FIG.6.

SPECIFICATION

Asynchronous sheet stacking apparatus

The present invention relates to an asynchronous sheet stacking apparatus particularly, but not exclusively, for stacking used banknotes.

The invention has use in machines designed for high speed handling of flexible sheets, for example record slips, bills and banknotes. These machines have as one of their main objectives, to process a number of sheets as quickly as possible, the process involving at some stage the stacking of sheets from a flowline into a pile. It is therefore requird to feed the sheets at high speed such as about 20 sheets per second to these stacking areas in the machine.

In one known sheet stacking apparatus a rotating wheel is used containing slots which originate near the centre and spiral out around its axial to its periphery, two slots defining the shape of a tine.

The wheel is rotated such that its peripheral speed is lower than that of the flowline and in a manner such that the slots are presented tangentially to the flowline. The leading edge of an oncoming sheet travelling at a greater linear speed than that of the periphery of the wheel is directed into the entrance of the slot presented there and part or all of the sheet is then delivered into the slot. The sheets once in the slots of the wheel are later stripped off during the continuation of the rotation of the wheel, to form a stack of sheets. With this wheel, some degree of synchronisation is required between the wheel itself and the leading edge of an oncoming sheet so that a successful entrance of a sheet's leading edge into a sheet receiving slot occurs. Suitably modified, these wheels may be used in asynchronous flowlines of sheets, but the possibility of coincidence of a tine from the wheel with the leading edge of an oncoming sheet is always present, causing in stacking operations fouling in the handling of the sheets.

The aim of the present invention is to provide a means of controlling sheets from an asynchronous flowline and stacking them onto a surface.

According to the invention there is provided an asynchronous sheet stacking apparatus comprising a sheet feeding means, a sheet support surface on which the sheets are to be stacked, an alignment surface against which the stacked sheets are to be aligned, and a rotatable member carrying a plurality of flexible flails, the arrangement being such that when the rotatable member is rotated the flails strike the sheets being fed by the feeding means and so direct them as to form a stack on the support surface and abutting the alignment surface.

Preferably, the alignment surface is formed by spaced projections between which the flails pass.

The flails are then preferably arranged in axially spaced groups to facilitate their passing between the projections.

Preferably the rotatable member is elongate and the flails are distributed along the length of the rotatable member.

The elongate member is conveniently in the form of a roller.

The alignment surface preferably lies in a plane which is substantially parallel to the axis of rotation of the rotatable member.

The feeding means may be arranged to feed sheets at any convenient angle relative to the alignment surface. In one preferred embodiment the sheets are fed by the feeding means in a direction normal to the alignment surface, but in another preferred embodiment the sheets are fed in a direction parallel to the alignment surface, but intermediate angles would be possible.

The support surface is preferably made to be movable relative to the axis of the rotatable member to accommodate a stack of sheets of increasing height.

The invention will now be further described, by way of example only, with reference to the accompanying diagrammatic drawings in which:-

Figure 1 is a perspective view of a first banknote stacking apparatus in accordance with the invention;

Figure 2 is a side veiw of the apparatus of Figure 1 looking in the direction of the arrow X, and showing the formation of a stack of notes;

Figure 3 is an end view looking in the direction of arrow Y in Figure 1;

Figure 4 is a perspective view of a second banknote stacking apparatus in accordance with the invention;

Figure 5 is a side view of the apparatus of Figure 4 looking in the direction of the arrow W; and

Figure 6 is an end view looking in the direction of the arrow Z in Figure 4.

The banknote stacking apparatus of Figures 1 to 3 comprises a rotatable member in the form of a roller 1 from the cylindrical surface of which a plurality of flails 2 extend, a support surface in the form of a flat horizontal platform 3 upon which the stack forms, an alignment surface which is formed by spaced vertical projections 4 between which the flails 2 pass. The feeding device shown comprises a plurality of rollers 5 and belts 6. Other types of feeding devices may be used as long as they are capable of delivering the banknotes at the correct orientation and speed which is dependent on the orientation and speed of the rotatable roller 1. In this arrangement the banknotes are fed with their shorter edges parallel to the feed direction.

The roller 1 is rotatably mounted about its longitudinal axis, and the direction in which the roller 1 is continuously rotated by suitable drive means is indicated by arrow R in Figure 2.

Banknotes are projected asynchronously by the feed mechanism 5, 6 into the path of the rotating flexible flails 2 where they are struck and brought against the flat platform 3 or the free surface of an existing stack of notes. The rotating flexible flails 2 in this apparatus move in planes which are parallel to the feed direction of the banknotes and impart a frictional effect on the banknotes to bring and keep them against the alignment surface formed by the projections 4.

In this apparatus the axis of rotation of the roller is located above the level of the feed path from the feed means 5, 6 and the direction of rotation of the roller is such that the flails 2 strike the banknotes to direct them both downwards and towards projec-

tions 4.

As shown in Figure 3, the flails are arranged in five axially spaced groups of four, the flails of each group being angularly spaced from one another.

Typically, for banknotes, the roller 1 has a diameter of about 50 mm, and the flails are made of threads, for example nylon, measuring 0.4 mm in diameter and about 100 mm in length. However, the diameter of the roller, the dimensions and arrangement of the flails, and the speed of rotation of the roller may be varied quite widely to suit different applications.

In a particularly useful construction the flat platform 3 can be made to be movable relative to the axis of the rotatable roller 1 to accommodate a stack of notes of increasing height. For example this may be done by the use of a servo-mechanism controlling the position of the flat platform 3 according to the number of banknotes in the stack. Alternatively this may be done by the use of a cam or wheel acting on the free surface of the stack of banknotes thereby keeping it at a constant position relative to the roller 1.

Figures 4 to 6 show a modified stacking apparatus which largely consists of identical components to that of Figures 1 to 3, but the direction of feed of the banknotes by the feed means in this arrangement is substantially parallel to that of the roller axis, the banknotes being fed with their longer edges parallel to the feed direction. Parts corresponding to those of Figures 1 to 3 having been given identical reference numbers. A second vertical alignment surface 7 is provided in this arrangement to absorb any residual kinetic energy of the banknotes after they have been struck by the flails, the surface 7 extending normally to the surface defined by the vertical projections 4, and normally of the feed direction of the feed device 5, 6.

In this arrangement the flails 2 sweep transversely across the feed direction of the notes to draw them against the projections 4, and the kinetic energy of the notes is relied upon to bring the notes into abutment with surface 7, and the result is that the stack is aligned against two alignment surfaces.

As the notes proceed axially of the roller 1 from the feed means 5, 6 they are struck by a progressively increasing number of flails so that a progressively increasing frictional resistance is applied to the notes to slow them down before they contact second alignment surface 7. At the same time the flails 2 are exerting a downwards force on the notes to urge them towards support surface 3, as with the arrangement of Figures 1 to 3.

As with the arrangement of Figures 1 to 3, the capacity of the arrangement of Figures 4 to 6 may be increased by arranging for the support surface 3 to be movable downwards by a servo-mechanism.

In addition, the size of notes which can be accommodated may be made variable by providing some means for adjusting the position of the alignment surface 7 in the direction parallel to the roller axis, as indicated by the arrow H in Figure 5.

CLAIMS

1. An asynchronous sheet stacking apparatus comprising a sheet feeding means, a sheet support surface on which the sheets are to be stacked, an alignment surface against which the stacked sheets are to be aligned, and a rotatable member carrying a plurality of flexible flails, the arrangement being such that when the rotatable member is rotated the flails strike the sheets being fed by the feeding means and so direct them as to form a stack on the support surface and abutting the alignment surface.

2. Apparatus as claimed in claim 1 in which the alignment surface is formed by spaced projections between which the flails pass.

3. Apparatus as claimed in claim 2 in which the flails are arranged in axially spaced groups to facilitate their passing between the projections.

4. Apparatus as claimed in any of the preceding claims in which the rotatable member is elongate and the flails are distributed along the length of the rotatable member.

5. Apparatus as claimed in claim 4 in which the elongate member is in the form of a roller.

6. Apparatus as claimed in any of the preceding claims in which the alignment surface lies in a plane which is substantially parallel to the axis of rotation of the rotatable member.

7. Apparatus as claimed in any of the preceding claims comprising means arranged to move the support surface relative to the axis of the rotatable member to accommodate a stack of sheets of increasing height.

8. An asynchronous sheet stacking apparatus substantially as described with reference to Figures 1 to 3 of the accompanying drawings.

9. An asynchronous sheet stacking apparatus substantially as described with reference to Figures 4 to 6 of the accompanying drawings.

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